United States Patent [19]

Lapointe

[11] **4,141,451**

[45] **Feb. 27, 1979**

[54] **CHIP THICKNESS CLASSIFIER**

[75] Inventor: **Joseph A. Lapointe,** Montreal, Canada

[73] Assignee: **Domtar Inc.,** Montreal, Canada

[21] Appl. No.: **866,838**

[22] Filed: **Jan. 4, 1978**

[51] **Int. Cl.**[2] **B07C 5/04**

[52] **U.S. Cl.** **209/664;** 209/667

[58] **Field of Search** 209/97, 98, 99, 101, 209/106, 107

[56] **References Cited**

U.S. PATENT DOCUMENTS

196,456	10/1877	Howard et al.	209/99
1,173,737	2/1916	Quesnell	209/106
1,185,770	6/1916	Cody	209/99
1,472,279	10/1923	Nordstrom	209/98
2,895,610	7/1959	Copping et al.	209/98
2,984,351	5/1961	Van Slyck et al.	209/98

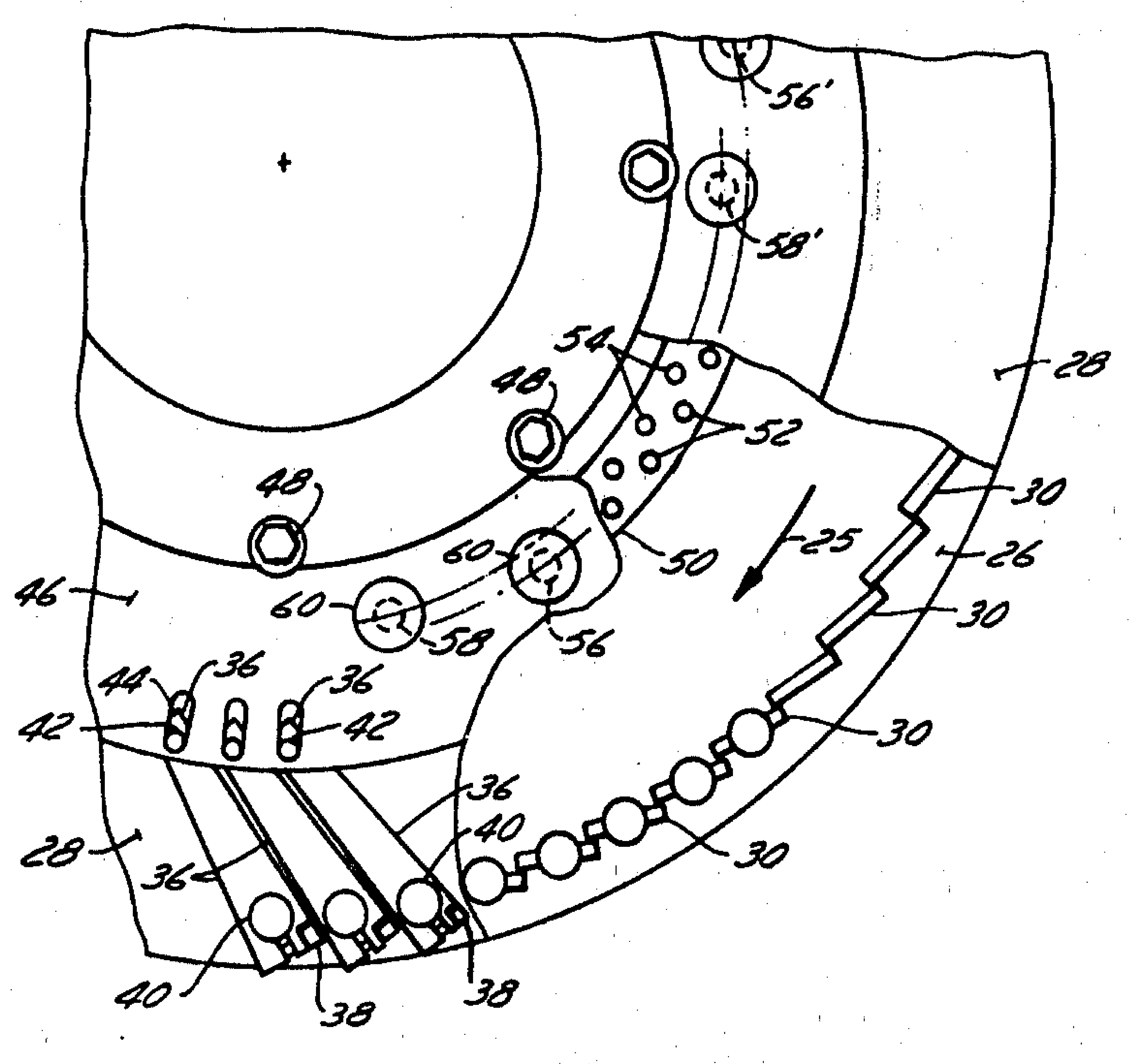
Primary Examiner—Joseph J. Rolla

Attorney, Agent, or Firm—C. A. Rowley

[57] **ABSTRACT**

A chip thickness classifier comprising a drum mounted for rotation about its longitudinal axis and having its periphery formed by a plurality of discrete longitudinally extending bars of elongated cross-section. The bars are arranged in substantially shingled relationship with one side of each bar spaced closer to the axis of rotation of the drum than the other side of the bar thereby to form outlet passages between adjacent bars. The outlet passages are substantially axially extending slots having their major width dimension measured substantially radially of the axis of rotation of the drum. Each of said bars is mounted for rotation about a longitudinally extending axis of the bar and the bars are interconnected by an adjustment mechanism that applies simultaneous incremental movement to stepwise rotate said bars and change said width dimension of the outlet passage. The drum is rotated in the direction wherein the side of each said bar closest the axis of rotation of the drum leads.

9 Claims, 6 Drawing Figures



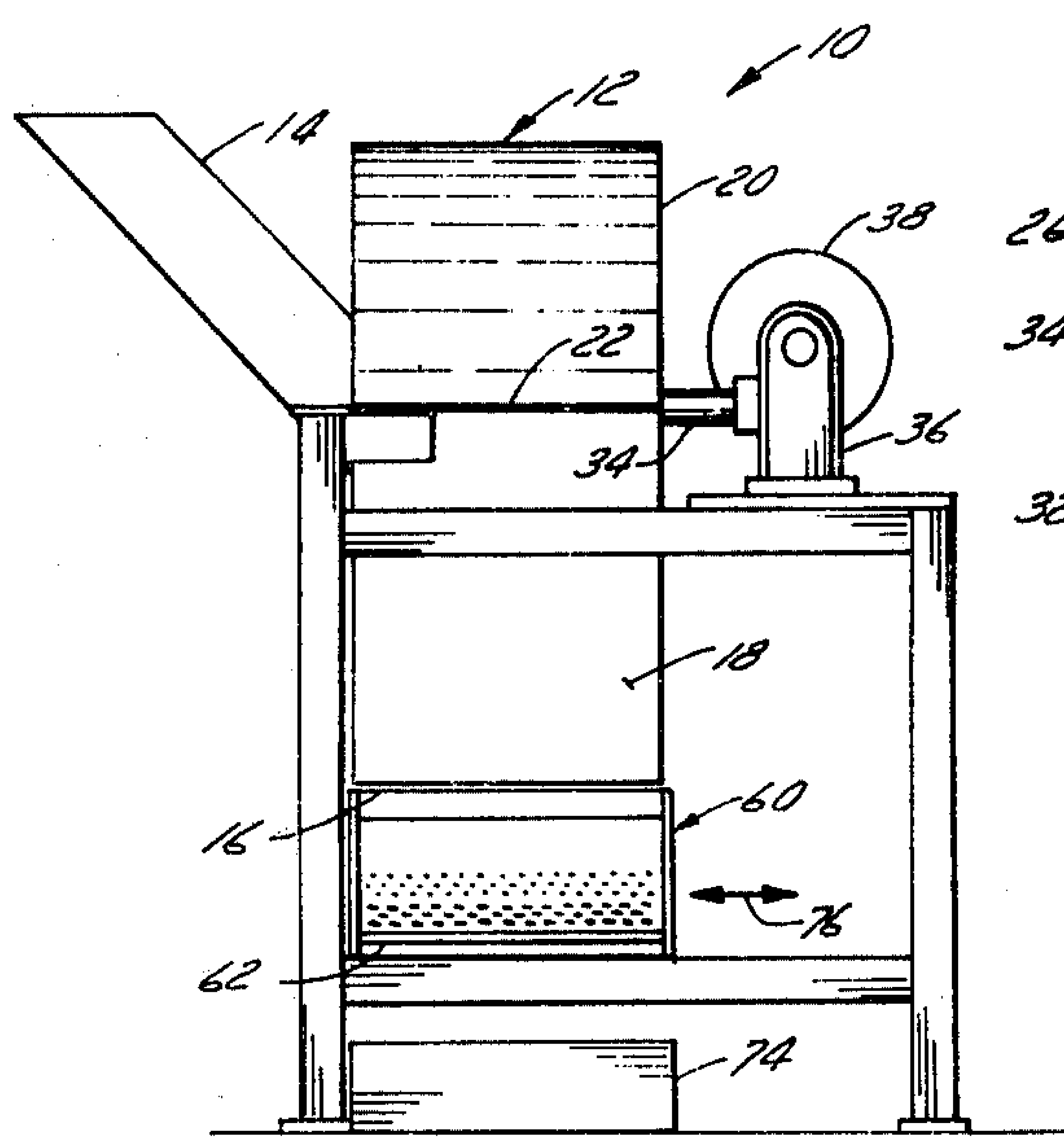


FIG. 1

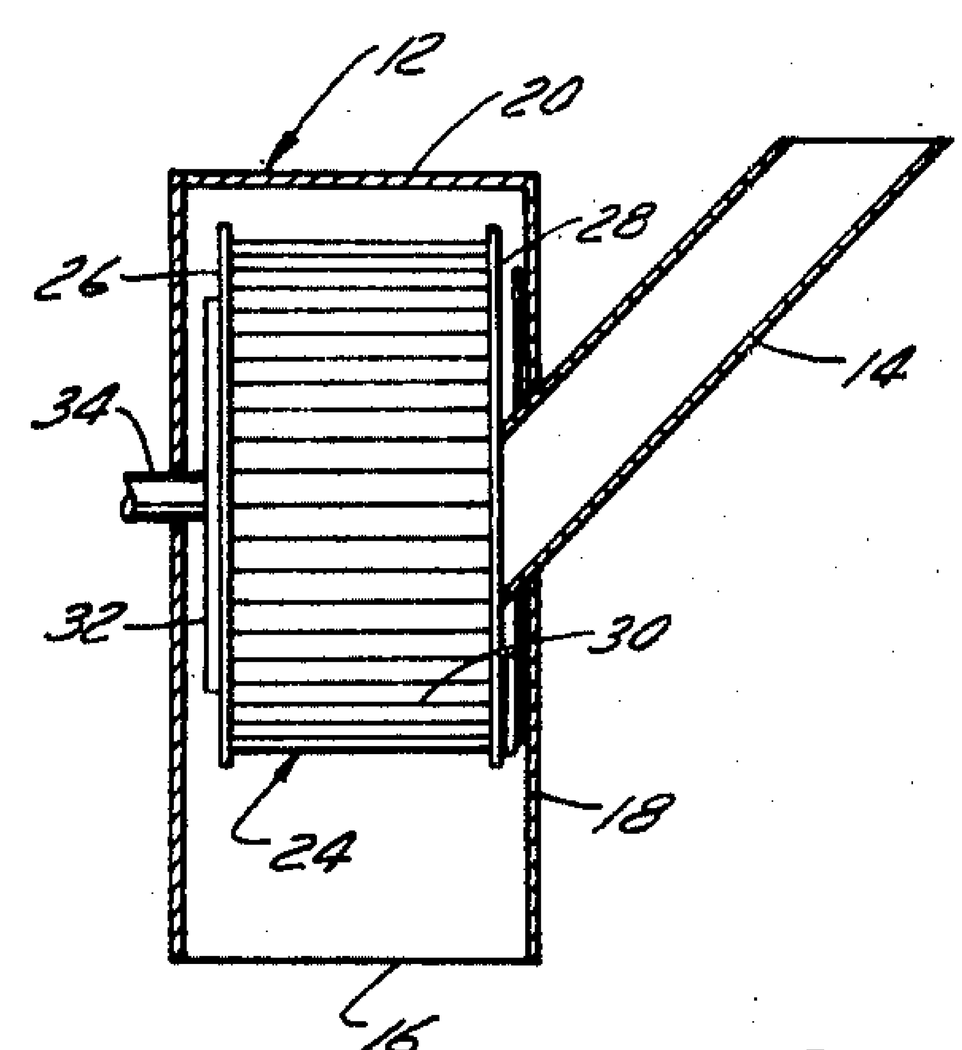


FIG. 3

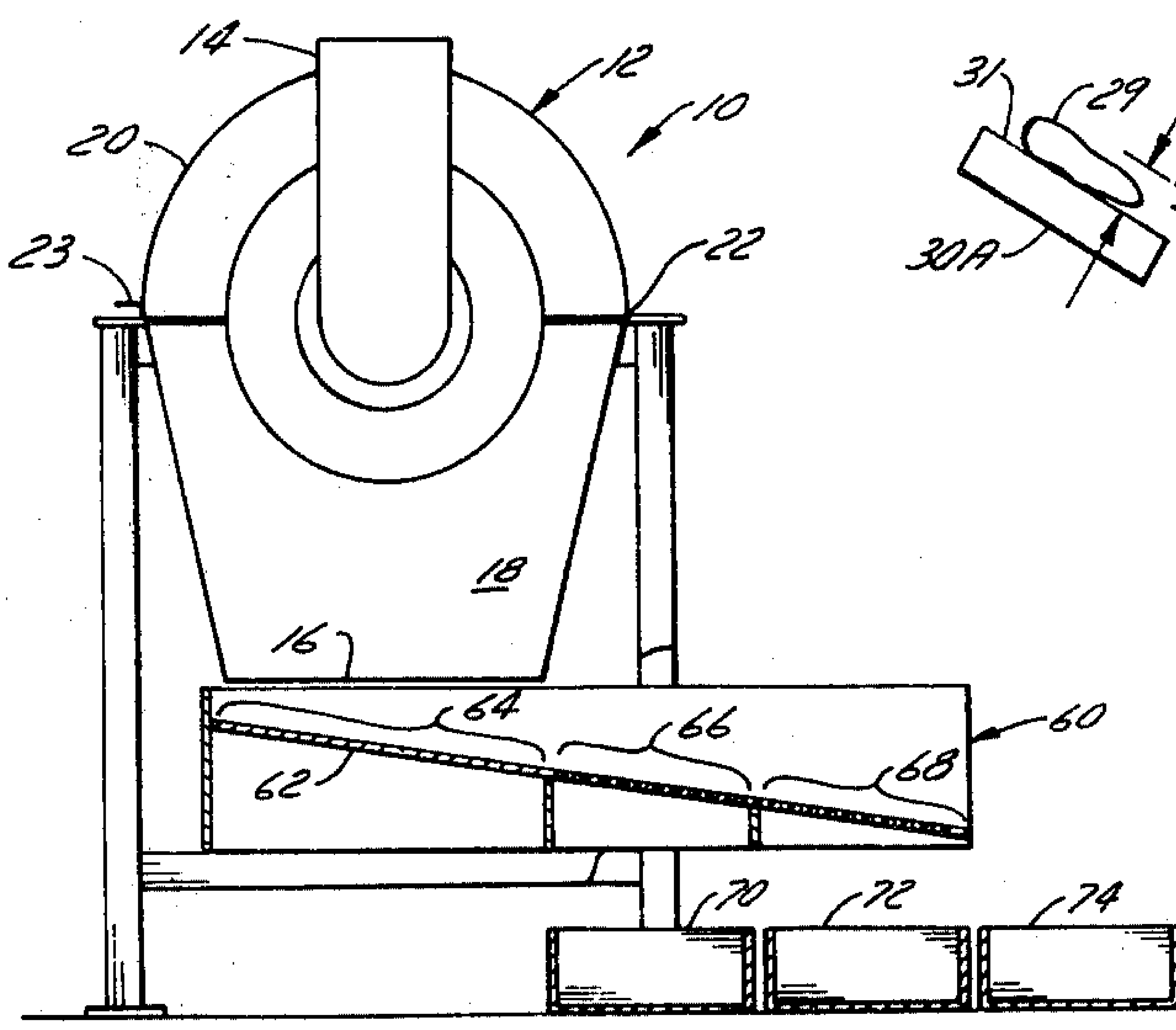


FIG. 2

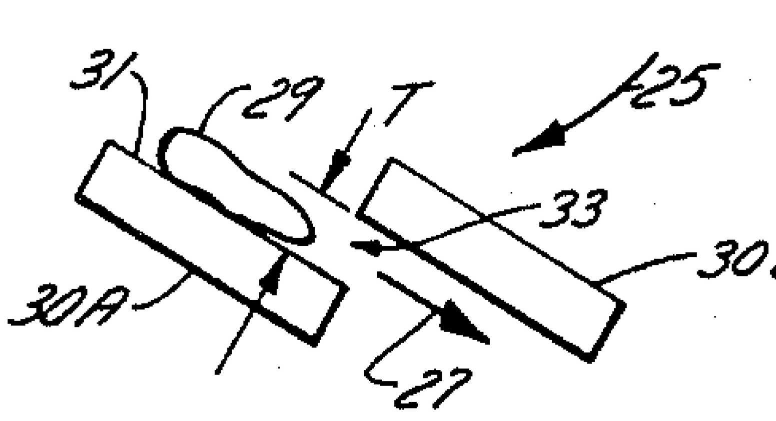


FIG. 5

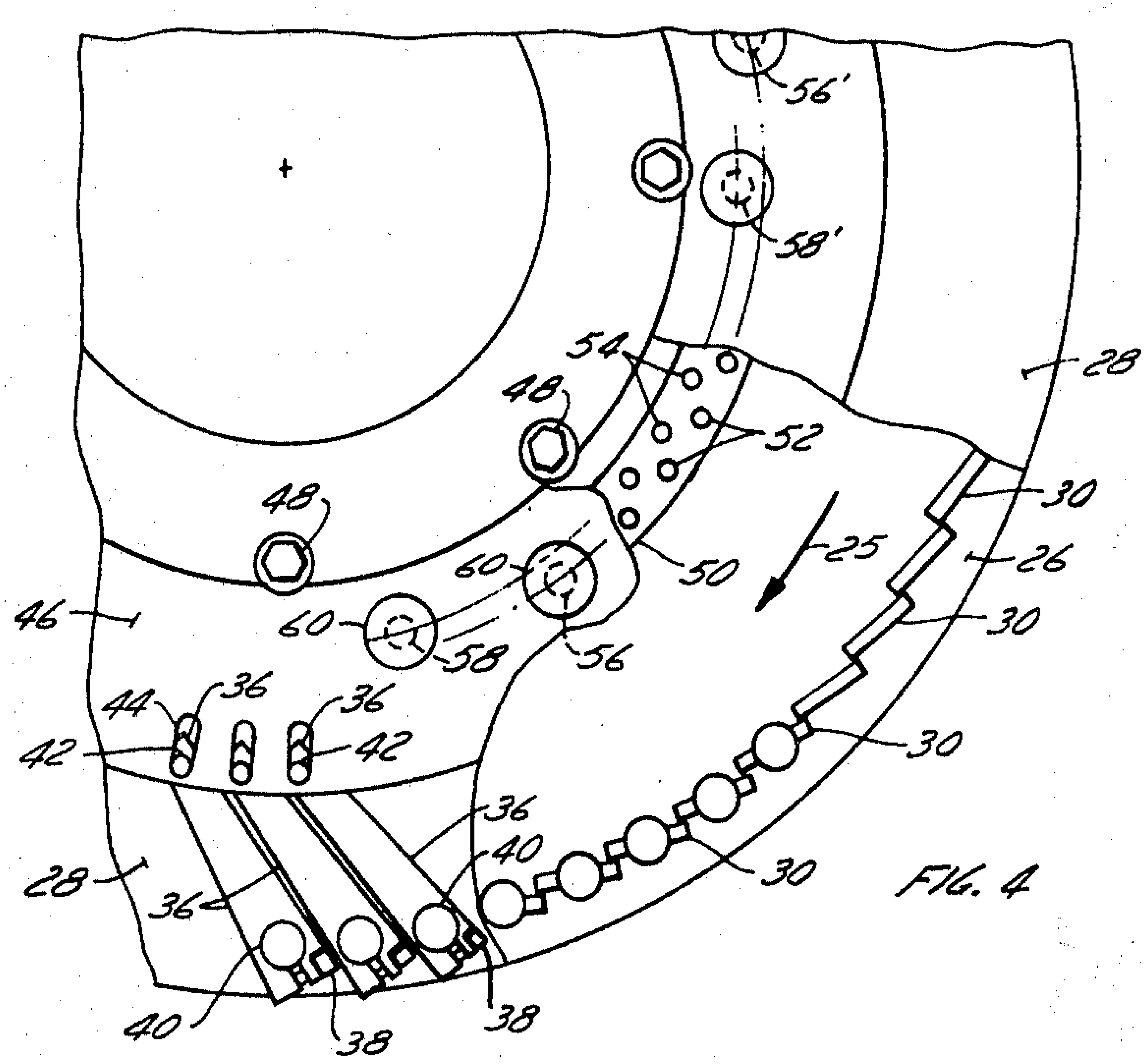

56'
58'
54
52
48
48
28
30
26
25
50
60
60
58
56
46
44
36
36
42
42
36
40
28
36
40
38
38
30
30

FIG. 4

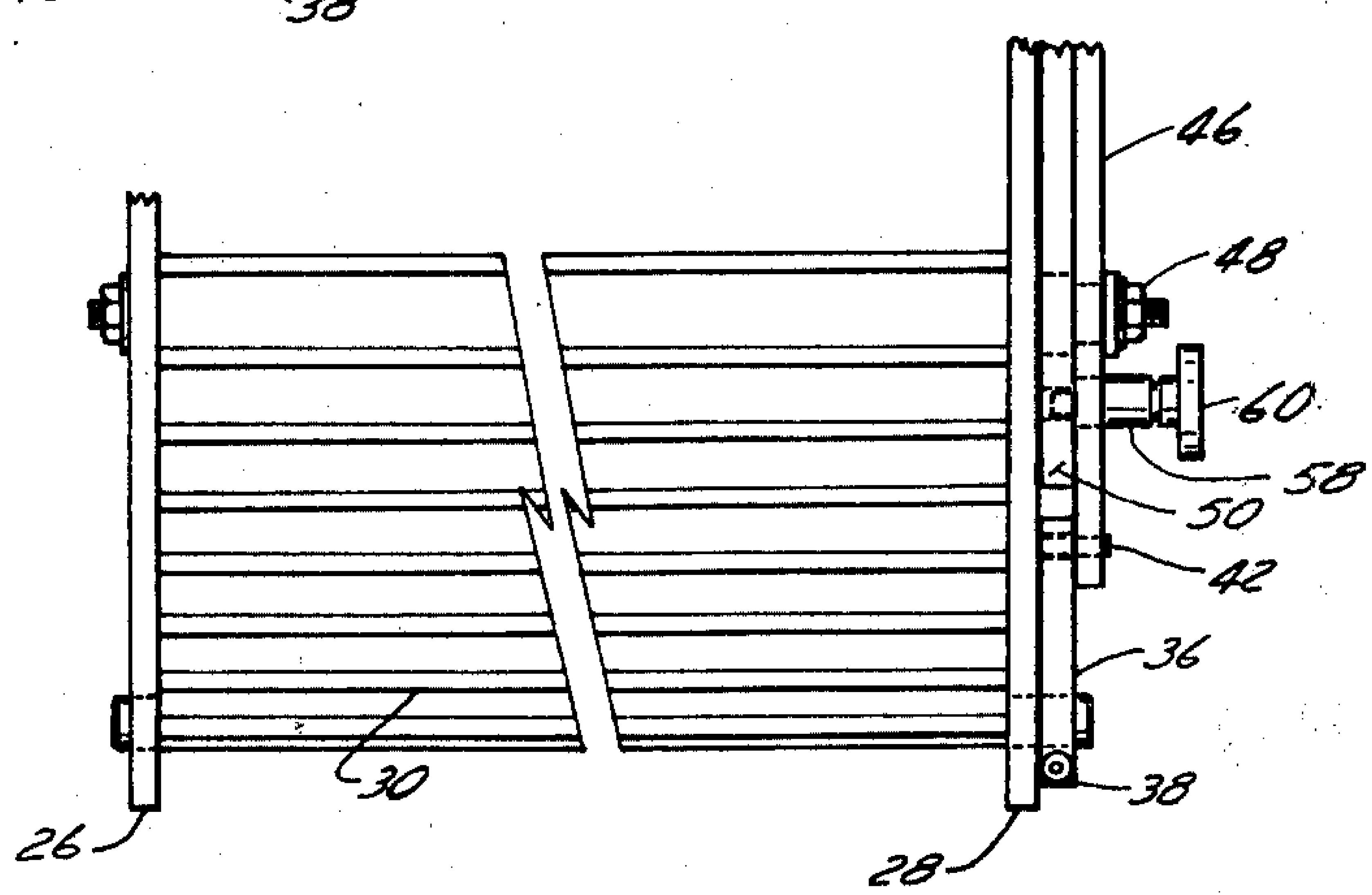

46
48
60
58
50
42
36
38
30
26
28

FIG. 6

CHIP THICKNESS CLASSIFIER

FIELD OF THE INVENTION

The present invention relates to a chip thickness classifier, more particularly the present invention relates to a device for classifying chips by thickness to a plurality of different thickness ranges.

BACKGROUND OF THE INVENTION

Generally chips are classified using a screen to give a chip analysis based on size rather than thickness. For example, TAPPI test RC16 superseded by useful method 21 (March 1974) specifies the use of an apparatus consisting of a plurality of screen plates mounted one on top of the other that are shaken for a period of time to classify the chips into the various size fractions.

A similar device has been designed for classifying chips in accordance with thickness, however, this device has not been generally accepted in the trade. It consists of a plurality of trays similar to that described hereinabove with respect to the TAPPI tests but with a plurality of parallel wires functioning as the screening elements. As in the TAPPI procedure, the trays are laid one upon another and shaken for a period of time to permit chips to be classified.

Other devices have been proposed for sorting or classifying chips in accordance with their thickness, however, to date, none have gained wide spread acceptance by industry because of their complicated nature, difficulty of operation and poor reliability. Thus there is no recognized standard chip thickness classification instrument or technique available.

It has been proposed to segregate mail by thickness using a rotary drum type apparatus as disclosed in Canadian Pat. No. 595,103 issued Mar. 8, 1962, Copping et al. In this device a plurality of plates are each mounted on a pair of brackets fixed one to each end of each plate and pivotedly mounted in a pair of annular end frame members to form the drum. The brackets are eccentrically weighted so that the plates pivot as the drum is rotated, thereby to increase the clearance between adjacent plates from a minimum clearance at the bottom to a maximum at the top of the rotation to free material trapped between adjacent plates so that it may fall back towards the centre of the drum. There is only a single setting whereby all the materials larger than a certain thickness will be retained and all the materials smaller than that thickness may pass between the adjacent plates.

It has also been proposed to grade beans utilizing a rotary drum type bean separator as disclosed in Canadian Pat. No. 788,300 issued June 25, 1968 to Grospety. The bean grader of this patent composed of a pair of end discs interconnected by fixed rods and expandable elements therebetween. The thickness or width of the expandable elements may be adjusted to vary the clearances between the expandable element and a pair of fixed transverse rods positioned one on each side of the expandable elements. The expansion is controlled by the position of a cam plate that can be moved axially relative to the drum to change the minimum expansion setting. The cam plate is provided with a camming surface that changes the expanded condition of the expandable members as the drum rotates, i.e. the expandable elements are at their maximum expansion for the particular cam setting during the bottom half of their rotation, and at a minimum thickness during the top half of their rotation the concept being that any materials wedged between the expandable members and the fixed rods will be released as the expandable members contract and will fall into the drum.

Neither the letter sorter of Canadian Pat. No. 594,103, nor the bean sorter Canadian Pat. No. 788,300 provide the means for separation capable of the classification of chips by thickness to provide a plurality of different thickness range fractions of the chips.

BRIEF DESCRIPTION OF THE INVENTION

The present invention provides a new concept for classifying chips in accordance with chip thickness.

Broadly the present invention comprises a drum mounted for rotation about its longitudinal axis, a plurality of discrete longitudinally extending bars of elongated cross-section arranged to extend substantially longitudinally of and to form the circumference of the drum with each of the bars being mounted to rotate about one of its longitudinal axes. The bars are positioned in substantially shingled relationship with one side of each bar radially spaced inwardly of the other side of its immediately adjacent bar thereby to form outlet passages between adjacent bars. The outlet passages are in the form of elongated slots extending substantially longitudinally of the drum and have their major width dimension measured substantially radially relative to the axis of the drum. An adjustment mechanism is connected to each of the bars whereby the adjustment mechanism applies simultaneous incremental rotational movement to all of the bars about their said longitudinal axis to rotate the bars and adjust step-wise the width of the passage between each pair of adjacent bars, and a latch mechanism locks the adjustment mechanism in various positions.

BRIEF DESCRIPTION OF THE DRAWINGS

Further features, objects and advantages will be evident from the following detailed description of the preferred embodiment of the present invention taken in conjunction with the accompanying drawings in which:

FIG. **1** is a side elevation of a chip thickness classifier incorporating the present invention.

FIG. **2** is an end view of the chip thickness classifier of FIG. **1**.

FIG. **3** is a partial section illustrating the arrangement of the chip thickness classifier of FIGS. **1** and **2**.

FIG. **4** is an enlarged cut-away view illustrating the adjustment mechanism for the screening rods, and

FIG. **5** is an isolated schematic cross section of a pair of adjacent securing bars illustrating the operation of the outlet passage between each pair of adjacent bars.

FIG. **6** is a view of the rotor illustrating the lateral position of the elements of the adjusting mechanism.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in FIGS. **1**, **2** and **3** the chip thickness classifier **10** of the present invention includes a housing **12** having an inlet spout **14** and a bottom outlet **16**. The housing **12** is formed of a bottom section **18** having an upper section **20**, pivoted thereto as indicated by the pivot **22** and liftable by the handle **23** to provide access to the classifying drum **24** contained within the housing.

The drum **24** is formed by a pair of annular end plates **26** and **28** each of which pivotably mounts opposite ends of screening bars **30**, of elongated cross section which make up the circumference of the drum **24**.

A mounting plate **32** is connected to the end plate **26** and closes one end of the drum **24**. The inlet spout **14** communicates with the hole in the annular plate **28** to permit a chip sample to enter the drum.

The drum **24** is mounted via a shaft **34** that projects from the center of the plate **32** and is connected through a gear reducer **36** with the drive motor **38** (FIG. **1**) whereby the drum **24** is rotated in the direction of the arrow **25** (see FIG. **4**). This direction of rotation is important to the operation of the separator as will be described hereinbelow.

Each of these screening bars **30** is a substantially flat bar having axially extending stub shafts at each end. These stub shafts, in the illustrated arrangement, have their longitudinal axis aligned with the longitudinal axis of the bar **30**, however, this positioning is not critical, i.e. the stub could be shifted to either side of the bar. It is preferred that they be at the side edge of the bar closest to the axis of rotation of the drum so that the opening operation does not require lifting the chips. These stub shafts at the ends of the bars **30** are rotatably mounted in the plates **26** and **28** and arranged in a circle about the axis of rotation (shaft **34**) of the drum **24** as shown in FIG. **4**. It is preferred that adjacent side edges of adjacent said bars be positioned in shingled relationship i.e. there be a slight overlap of one side edge of one bar with the other side edge of an adjacent bar, however, this is not absolutely essential and the overlap may be omitted so that adjacent sides of adjacent bars may be spaced slightly in the circumferencial direction of the drum. Hence, the term "substantially shingled" is used in the disclosure to include a shingled relationship of adjacent bars or one wherein there is a slight circumferential spacing. It is important that the said one side of each bar be radially spaced relative to the other side of the adjacent bar so that the one edge is closer to the axis of rotation of the drum **24** than the said other side. By so mounting the adjacent bars **30** an outlet passage **33** (see FIG. **5**) is formed between pairs of adjacent bars to permit chips to move along the inner surface **31** of one of the bars and to escape from the drum in a substantially circumferential (or tangential) direction. The maximum dimension of the passage **33** between a pair of adjacent bars **30** will be measured substantially radially of the drum i.e. in a substantially axial plane as indicated by dimention T, so that the chips sliding out on the surface **31** of a bar need not change direction significantly to exit from the drum. If there was a larger circumferential spacing between adjacent side edges of adjacent bars **30** than the narrowest setting for dimension T of the passages **33** some of the chips could leave the drum **24** in a substantially radial direction and the accuracy of the test would be lost.

In the illustrated arrangement wherein 60 bars are provided on a 24 inch diameter drum each bar is approximately 1¼ inch wide and the overlap between one side and the other side of an adjacent bar is approximately ⅛ of an inch i.e. the overlap at each side of each bar is approximately ⅛ of an inch.

The stub shaft for each of the screening bars **30** at one end of the drum **24** (in the illustrated arrangement at end of plate **28**) project through the plate **28** (or **26**) and each is provided with a rigidly connected arm **36** which in the illustrated arrangement is connected via a friction fit formed by tightening of the bolts **38** to clamp the stub shafts at the end of bars **30** in the slots **40**. In a commercial model each arm **36** would probably be keyed in some way to the respective bar **30** so when an arm is replaced it would automatically be aligned with the other arms.

The opposite ends of the arms **36** are provided with pins **42** that are received within substantially radial slots **44** formed in a thickness setting ring **46** which is mounted for rotation relative to the end plates **26** and **28** on the bearings formed on the bolts **48** threaded into the end plate **28**. The ring **46** is spaced from the end plate **28** via spacers on bolts **48** (not indicated) and an annular spacer **50** concentric with the opening in the plate **28**. This spacing between the ring **46** and annular end plate **28** is sufficient accommodate the ends of the arms **36** as shown in FIG. **5**.

The spacer **50** is provided with a pair of concentric rows of holes **52** and **54**. The circumferential spacing between a pair of adjacent holes **52** and **54** in the rows determines the incremental adjustment of the bars **30**. A pair of spring loaded plungers **56** and **58** extend through the adjustment ring **46** in a position to cooperate with the annular ring of holes **52** and **54** respectively. These spring loaded plungers **56** and **58** may be lifted from their respective holes **52** and **54** by lifting the hand grip portion **60** thereof (see FIGS. **4** and **5**) moving the spring loaded pins. This arrangement significantly reduces the possibility of overshooting the adjustment since only one of the pins **56** or **58** is manipulated for any given adjustment and movement of the annular adjustment ring **46** can only proceed until the nonmanually retracted pin **56** or **58** overlies a hole **52** or **54** at which time that spring loaded pin will force itself into the hole and prevent rotation.

Only a single spring loaded pin **58** and **56** has been described, however, it is preferred to provide the two pins to cooperate with each of the rows of holes **52** or **54** (see pins **56'** and **58'**) so that two pins must be withdrawn from one of the annular row of holes **52** or **54** e.g. the two pins **56** and **56'** must be retracted from holes **52** to permit rotation of the ring **46**. This use of two pins facilitates rotation since both hands contribute to the rotational forces. Furthermore since both hands are required to make the adjustment the possibility of overshooting (opening too much) is eliminated since the pins in holes **52** and **54** cannot be simultaneously manually retracted by an operator.

Positioned beneath the outlet **16** is a tray **60** which, as schematically illustrated, is provided with a sloped bottom **62** (see FIG. **2**). Sloped bottom **62** is divided into three sections designated by the numerals **64**, **66** and **68** respectively. The section **64** immediately below the outlet **16** is not perforated. Section **66** offset from the outlet is provided with a plurality of small holes which functions as a fines screen so that short fibre material leaving the drum **24** with the chips is separated as the sample passes over the screen section **66**. Section **68** is provided with a plurality of holes of larger diameter and sized to pass any chips of an acceptable size. Positioned beneath the section **66** is a tray **70** to catch the short fibre fraction and positioned beneath the section **68** is a tray **72** which receives the desired sample. A tray **74** is provided at the end of the tray **60** to catch the oversized material having one dimension greater than the size of the hole in section **68** (generally splinters and the like). Preferably short imperforated sections will be provided between the sections **66** and **68** and between the section **68** and the end of the tray.

It is important that the section **66** not be positioned directly beneath the outlet **16** so that the chips fall onto the imperforate section **64** and orient themselves generally with their long dimension substantially parallel to the bottom **62**. Providing this opportunity for the chips to so align improves the accuracy of the separation by length (the long chips that pass over the section **68** have less tendency to tip and fall through the holes).

The tray **60** is oscilated from side to side by a suitable mechanism schematically represented by arrow **76**.

In operation the screen bars **30** are moved to their first setting, i.e. first opening from the position illustrated in FIG. **4**. The sample of chips to be classified is inserted into the drum by the inlet chute **14** with the bars in the above described first position or closed position. Generally with the illustrated arrangement using a drum of about 21 inches in diameter in a housing about 12 inches in the axial dimension a random sample of about 1,500 to 2,000 grams is used. The sample size may change depending on the moisture content or sample composition. Motor **38** is then activated to drive via reducing gear **36** the shaft **34** and thereby the drum **24** to apply a tumbling action to the chips. As above indicated the direction of rotation designated by the arrow **25** is important it being essential that the inner side (side close to the axis of rotation of the drum) of each of the bars **30** lead in the direction of movement. This direction of movement permits these inner sides of the bars to function as lifting flights or lifters to help lift and tumble the chips as the drum rotates. Also this direction of rotation tends to move the bars relative to chips laying thereupon so that these chips tend to exit in a tangential direction by sliding out the outlet formed between a pair of adjacent bars i.e. in the direction of the arrow **27** shown in FIG. **5**. Basically what happens is a chip as schematically illustrated at **29** in FIG. **5** lies in face to face relationship with the upper surface **31** of the leading bar indicated at **30A** in FIG. **5** and tends to slide down the face **31** as the drum moves in the direction of the arrow **25** so that the chip passes through the substantially tangential outlet opening **33** formed between the leading bar **30A** and the trailing **30B**.

The chips of the pre-selected thickness designated by the size of outlet **33** (spacing T FIG. **5**) slide out of the drum through the outlets **33** between the adjacent bars **30** onto the tray **60**. The tray **60** is oscillated back and forth as indicated by the arrow **76**, the direction of oscillation being at right angles to the direction of movement of the chips down the incline bottom **62** of the tray **60**. This lateral movement of the tray **60** relative to the direction of sliding motion compared with tray movement in the direction of sliding motion slows the descent of the chips and improves the screening action in the tray **60**.

As the chips traverse the perforated section **66** the short fibre fractions are separated therefrom and fall through the perforations in the section **66** into the tray **72**. Those chips that pass over the section **66** reach the section **68** and assuming they are of the desired size they will pass through the apertures as in the section **68** and fall into the tray **72**, i.e. the size of the holes or apertures in section **68** will be such that any chip with a maximum dimension less than a certain specified maximum dimension will fall therethrough. Those chips having one dimension longer than the preselected dimension (size of opening of the apertures in the section **68**) normally slide off the end of the tray **60** into the receiving tray **74**. The combination of the metering action of the drum, the direction of tray movement and the orientation of the chips by the imperforate section **64** ensures that substantially all of the overlength chips do not fall through the holes in section **68** but pass over tray **62** into receiving tray **74**.

After a predetermined period of time the rotor **38** is stopped (when no more chips are leaving the drum **24**) the tray **70** is removed and a new tray provided. The spacing between adjacent bars **30** is then adjusted by retracting the inserted pair of spring loaded pins say **58** and **58'** and the ring **46** rotated relative to the plate **28** to increase the clearance T between the adjacent bars **30** until the pins **56, 56'** are spring driven into the holes **52** in the spacer **50**.

The above procedure of rotating the drum, oscillating the tray **60** and collecting the desired sample in the tray replacing tray **70** is then repeated. The whole operation is repeated as many times as required to obtain the chip thickness distribution of the initial sample.

The rotation of the ring **46** relative to the end plate **28** causes the sides of the slots **44** to engage the pins **42** and move the ends of the arms **36** in a direction which pivots each of the bars **30** about a longitudinal axis and thereby moves the side edges of these bars apart.

Access to the pins **56, 56'** and **58, 58'** is obtainable by providing a suitable opening in the housing. The manner of doing this, used on the prototype equipment was to pivotably mount the inlet chute **14** on the housing and use the inlet chute to define a portion of the front of the housing **18**.

The latching mechanism which requires the retraction of a pin or pair of pins while leaving a second pin or pair of pins free ensures that when the second pin or pair of pins is moved by rotation of the adjustment ring into position over a suitably located aperture the pins automatically enter the aperture and there can be no accidental overshooting of the next adjustment. Without such a positive arrangement to permit overshooting there could be an accidental loss of sample if the bars **30** were opened too wide and then returned to their proper incremental setting.

Modification may be made without departing from the spirit of the invention as defined in the appended claims.

I claim:

1. A chip thickness classifier comprising a drum mounted for rotation about its longitudinal axis, a plurality of discrete longitudinally extending bars of elongated cross-section arranged to extend substantially longitudinally of and to form the circumference of said drum, each of said bars being mounted for rotation about a longitudinally extending axis of said bar, said bars being positioned in substantially shingled relationship with one side of each said bar radially spaced inwardly of the other side of its immediately adjacent bar thereby to form outlet passages between adjacent bars, said outlet passages being in the form of slots extending longitudinally of said drum and having their maximum width measured substantially radially relative to said axis of said drum, an adjustment mechanism, means interconnecting each of said bars with said adjustment mechanism for simultaneous incremental rotational movement of all of said bars about their said longitudinally extending axes by said adjustment mechanism thereby to stepwise rotate said bars and adjust said width of said outlet passages between each pair of adjacent said bars and latch means to lock said adjustment mechanism in an adjusted position.

2. A chip thickness classifier as defined in claim **1** wherein said means inter-connecting each of said bars with said adjustment mechanism comprises a plurality of discrete arms, one of said arms fixed to each of said bars and connected to said adjustment mechanism at a point spaced from said bars.

3. A chip thickness classifier as defined in claim 2 wherein said adjustment mechanism comprises an adjustment ring, and wherein said arms are connected to said adjustment ring by means of a pin and slot connection, said adjustment ring being mounted for rotation about the axis of rotation of said drum.

4. A chip thickness classifier as defined in claim 3 wherein said latch means comprises at least two retractable pins on said adjustment ring, a spacer plate mounted on said drum, holes in said spacer plate arranged in concentric circles, the holes in one of said circles being in a position to be engaged by said one of said pins and the holes in the other of said circles being in a position to be engaged by the other of said pins.

5. A chip thickness classifier as defined in claim 4 wherein four of said retractable pins are provided to engage in said holes.

6. A chip thickness classifier as defined in claim 1 further comprising a tray positioned beneath an outlet from said classifier, a sloping bottom in said tray, said sloping bottom extending beyond the outlet of said classifier, a fines screen formed in said sloping bottom beyond said outlet.

7. A chip thickness classifier as defined in claim 6 wherein a second screen is provided in said sloped bottom beyond said fines screen in the direction of travel of said chips down said sloped bottom, said second screen being formed with holes through which chips of the maximum acceptable size pass.

8. A chip thickness classifier as defined in claim 6 wherein said tray is reciprocated in a direction substantially perpendicular to the direction of movement of said chips as they slide down said sloping bottom.

9. A chip thickness classifier as defined in claim 8 wherein a second screen is provided in said sloped bottom beyond said fines screen in the direction of travel of said chips down said sloped bottom, said second screen being formed with holes through which chips of the maximum acceptable size pass.

* * * * *